UNCLASSIFIED

AD NUMBER
AD428223
LIMITATION CHANGES
TO: **Approved for public release; distribution is unlimited. Document partially illegible.**
FROM: **Distribution authorized to U.S. Gov't. agencies and their contractors; Administrative/Operational Use; AUG 1963. Other requests shall be referred to Ballistic Research Laboratories, Aberdeen Proving Ground, MD 21005. Document partially illegible.**
AUTHORITY
USAARADCOM ltr, 24 Feb 1981

THIS PAGE IS UNCLASSIFIED

NCLASSIFIED

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

BRL

MEMORANDUM REPORT NO. 1505
AUGUST 1963

SABOT-LAUNCHING SYSTEMS FOR EXPERIMENTAL PENETRATORS

Glenn Taylor

RDT & E Project No. 1M010501A005

BALLISTIC RESEARCH LABORATORIES

ABERDEEN PROVING GROUND, MARYLAND

DDC AVAILABILITY NOTICE

Qualified requesters may obtain copies of this report from DDC.

Foreign announcement and dissemination of this report by DDC is not authorized.

The findings in this report are not to be construed as an official Department of the Army position.

BALLISTIC RESEARCH LABORATORIES

MEMORANDUM REPORT NO. 1505

AUGUST 1963

SABOT-LAUNCHING SYSTEMS FOR EXPERIMENTAL PENETRATORS

Glenn Taylor

Exterior Ballistics Laboratory

RDT & E Project No. 1M010501A005

ABERDEEN PROVING GROUND, MARYLAND

B A L L I S T I C   R E S E A R C H   L A B O R A T O R I E S

MEMORANDUM REPORT NO. 1505

GTaylor/rhg
Aberdeen Proving Ground, Md.
August 1963

SABOT-LAUNCHING SYSTEMS FOR EXPERIMENTAL PENETRATORS

ABSTRACT

Performance details for special purpose, high velocity sabots are described. These sabots were designed and developed for launching high density projectiles, of rod form, with overall length to diameter ratios varying from less than one to twenty-five.

TABLE OF CONTENTS

INTRODUCTION

Auxiliary carriers, or sabots, have been used in tests to launch successfully, into free flight, scale configurations of bombs, aircraft, missile components and penetrator devices[1,2]. These tests have provided data on aerodynamic performance, terminal effects or survival of components[3]. In this report, saboting systems for rod form penetrator device of the base-push type and combinations of push and pull will be described.

DESCRIPTION OF THE EXPERIMENT

The basic objective of this project was to develop a successful launching system for cylindrical models, axially aligned with the trajectory. The overall lengths and diameters varied as a ratio of length to diameter (L/D) from .75 to 25. The velocity for all tests was to be a maximum for the particular tube (gun) used for testing.

Evaluation of the launching was facilitated by stop-motion photography (Fastax smear technique)[4]. Velocity of the test configuration was calculated by the use of millisecond timing markers on the stop-motion photographs obtained from three Fastax cameras positioned at known distances along the trajectory. Muzzle velocity was determined by extrapolation back from the instrument velocity.

Two tubes were used during all tests. They were a smoothbore 105mm, T210 and a 90mm, T208. The maximum chamber pressure for the tests was set at 70,000 psi. The proper selection of powder charge for each firing had been established in previous tests with similar tubes and similar projectile weights[3].

Three basic types of rod form models were to be tested. They were manufactured from steel, tungsten, and Uranium 238. The L/D ratios of the models varied from .75 to 25; and the diameters for $L/D > 1$ were $< .6$ inch and for $L/D < 1$ the diameters were ≥ 1.5 inch.

Two types of sabot-launching systems, base-push and push-pull, were designed to be compatible with the test models and tubes (Fig. 1). The sabots were required to be mechanically suitable to carry the various models to maximum velocity. Previous experience with sabot design had indicated considerable dependence between the model design and the sabot design.

Relationships have been established, empirically, between the configuration of the model to be tested and the method of supporting and pushing the model to test velocity. These relations must be taken into consideration in the design of high performance sabots, especially in the use of the plastic state for isotropic materials and the visco-elastic properties of plastics.

Use of the base-push sabot of solid plastic is possible when the bore diameter of the tube, D_B, and the base diameter of an axially aligned rod form model, D_b, maintain the relationship $\frac{D_B}{D_b} \leq 2.5$ (conventional propellant launchers), For the optimum case, the base diameter of the model approaches the bore diameter of the tube $\frac{D_B}{D_b} \rightarrow 1$.

A case in point is the right cylinder of steel with L/D = .75. The $\frac{D_B}{D_b}$ ratio indicated that the largest bore usable would be 105mm (Figs. 2,3). In this borderline case, the visco-elastic resistance of materials must be relied on heavily.

In the majority of launching systems, the base-push method offers the simplest design. The type of model and the nature of launching forces to be experienced usually indicate the direction of design.

For the cylindrical model with the axis aligned with the trajectory, the base-push system of 100% plastic is always considered first; however, when the model's base bearing area is critical $\frac{D_B}{D_b} > 2.5$, the design is limited by possible failure due to compressive shear.

In those cases where $\frac{D_B}{D_b} > 2.5$, the usual solution to the problem is to add an auxiliary base. For tungsten models of L/D = 10, the sabot design was modified to supplement the base area by addition of an auxiliary, base or area multiplier, made of high strength aluminum alloy (Figs. 4,5). The model was manufactured from brittle tungsten. In an effort to reduce base damage to the very minimum, a cushion of plastic was sandwiched between the aluminum base multiplier and a steel disc, which was immediately behind the model.

Designs for L/D $>$ 10 are not as simple as those for L/D $<$ 10, due to the effect of transverse forces in the form of vibrations generated during the travel of the sabot through the bore. Friction, bore asymmetries, and the burning propellant yield vibrations that travel through the tube material and through the propellant gases. The model senses such vibration to the extent that fatigue may occur. In order to prevent fracture in models whose L/D $\geq$ 20, additional support must be provided (Fig. 6). It is interesting to note model failures of this type as shown in Figure 7.

With L/D $\geq$ 20, the design problem changes considerably. The model is now a very long slender rod of either tungsten or Uranium 238. Prior experience in saboting models with L/D $>$ 10 had indicated a push-pull method to be best (Fig. 1). Similar systems were utilized in the AP 90/40 fin stabilized projectile[5].

One modification to the basic model was required to adapt if for use with a push-pull sabot. The basic rod of tungsten or Uranium 238 would require a steel sleeve with machined detents to transmit the propelling force to the rod. The original material specified was chrome-moly steel tubing either shrunk or affixed with a suitable adhesive to the rod.

Sabot detents, of buttress form, were machined in the sleeve both with lead, as in a thread, and also in the form of grooves.

All of the models to be saboted had their centers of mass at approximately the midpoint of the longitudinal axis. Thus, in order to maintain equal portions of unsupported mass, the detent was machined equidistant from the center of mass (Fig. 8). The actual shear area consideration was based on the mass of the model and the propelling force. The calculated strength of materials with dynamic strength increase was used and no safety factor to yield point. This is reasonable due to the critical strength-to-weight ratio required for high velocity, from solid propellant launchers.

The load bearing portion of the sabot was designed in aluminum and machined to precisely match the detents. An aft stabilizing portion or subbase of plastic that also provided gas sealing or obturation was machined to match the rear of the aluminum portion of the sabot (Figs. 8,9).

Sealing or obturation is essential to achieve reasonable performance. While there are other types of obturation such as rubber rings and cups, this study indicated that solid plastic would be necessary due to the high temperatures and pressures anticipated. Experiments and actual saboting studies have yielded empirical factors for adequate obturation in solid propellant launchers. In such cases, the obturation is a significant part of the performance. Leakage can cause low velocity, incomplete burning of propellant and, in some cases, destruction of the sabot and model due to the erosion by passing gases. Thus, proper obturation of sabots manufactured of plastic is of the utmost importance. Experience has shown that there is an optimum interference ratio between the base diameter of the sabot, D_s, and the bore diameter of the tube, D_B

$$\frac{D_s}{D_B} = 1.024 \text{ or } D_s = 1.024 D_B$$

Usually, the sabot is seated in the origin of the bore by use of a hydraulic ram. The 1.024 constant is an empirical compromise that allows for ease of loading and also proper obturation.

Several test sabots of each type were manufactured, maintaining design prerequisites, and were subsequently tested.

ANALYSIS OF EXPERIMENTAL RESULTS

Each of the firing tests were grouped into three phases.

Test firings of rounds 5974 to 5978, from the 105mm T210 tube were successful and performed according to expectations. The data sheet, Figure 10, presents the various levels of performance achieved for all firings.

During the firing of this group of rounds, a severe breakup was noted of sabots for the models with L/D = .75 (Figs. 11, 12, 13). It is thought that elastic restoring forces in combination with stress risers acted upon the plastic sabot to cause disintegration upon emergence from the tube. However, disintegration of the sabot is permissible provided that the model achieves successful launch.

The first L/D = .75 model exhibited some yaw (Fig. 11); this was, however, the only projectile to do so. Analysis of performance of this shot seems to indicate partial failure of the sabot in the tube, thus allowing the model to rotate slightly.

Intermediate rounds 5975 and 5977 were base-push sabots with L/D = 10 models fired for maximum velocity. Both rounds were successful (Figs. 14,15), slightly exceeding Mach 7 and falling within the maximum limit of chamber pressure.

In the second phase, rounds 6346 to 6350 were launched from the 90mm T208 launch tube. The first two firings (6346, 6347) (Fig. 16, 17), were not successful due to the steel sheath shearing along the root of the buttress groove detent. Recovery of portions of the sabot, particularly the aluminum quarters, revealed that shearing had occurred; in fact, the remains of the steel detent grooves were still within the mating aluminum grooves. Investigation as to the cause of failure disclosed that the recommended material had been substituted by "spray on 80" steel. The stop-motion photographs (Figs. 16, 17) show the empty sabot emerging from the launcher. Chamber pressure measurements indicated that the projectile slipped rearwards and the resulting hole allowed some propellant gases to escape. The model was not recovered because it broke up within the tube.

In an effort to evaluate the dynamic strength of "spray on 80" steel, round 6348 and 6349 were launched at reduced chamber pressures (Figs. 18, 19). Both models were similar, with the only variation between 6348 and 6349 being in the aluminum alloy used in the sabot. Round 6348 aluminum was 7075ST6 and 6349 was 7178ST6. The purpose of the variation was to make a dynamic evaluation of materials at the designed chamber pressure; however, 6349 was used to make a sheath evaluation instead.

The reduced chamber pressure for firing round 6348 and the increased chamber pressure for round 6349 were evaluated, indicating that the "spray on 80" steel was critical above 48,000 psi. The failure repeated at 58,000 psi. The last round of the series, 6350 was fired at reduced chamber pressure and repeated the performance of round 6348. The model did break up but a study of the photographs indicated that the failure was due to defective core material and not the steel sheath (Fig. 20).

The third phase of the firings involved modified models of the type that formerly failed and also base-push L/D = 20 and 25 models. Round 6407 of the base-push design (Fig. 21) did not launch successfully (Fig. 7). There was not sufficient evidence to evaluate the performance of the projectile. Round 6408 used a push-pull sabot with a modified model of L/D = 25 with the steel sheath made of chrome-moly steel. The sabot was the same as those used in phase-two tests. The launch was successful with no apparent damage to the model. Chamber pressure was at the designed maximum for this firing (Fig. 22).

The final firing of this phase involved a model similar to the one launched (6407) previously, but with L/D = 20. The shorter model did not experience the same failure as round 6407 but did suffer breakage. The forward portion slowly rotated about the point of failure (Fig. 23). Experience has shown that this type of failure is normally associated with tensile failure of the model due to the reflection of the acceleration induced compressive wave back from the nose toward the rear of model.

SUMMARY

This series of firings has demonstrated that base-push sabots with models of $L/D \leq 10$ and push-pull sabots for models of $L/D > 10$ can perform well and achieve velocities in excess of 8000 ft/sec and 6500 ft/sec, respectively, when fired with solid propellant from conventional tubes at a limit chamber pressure of 70,000 psi. Furthermore, it has been shown that inherently weak materials such as Uranium 238 and very hard and brittle materials such as tungsten are suitable for projectiles of rod form with L/D from 10 to 25 when properly saboted and protected. Use of standard design methods, plus the use of empirical factors of area ratios of model to base and obturation interference, should make it possible to design systems for studying impact phenomena, defeating armor, and exploring the upper atmosphere with instrumented models[6].

Glenn Taylor

GLENN TAYLOR

INDEX OF FIGURES

REFERENCES

1. MacAllister, L. G. On the Use of Plastic Sabots for Free Flight Testing. BRL Memorandum Report No. 782, May 1954.

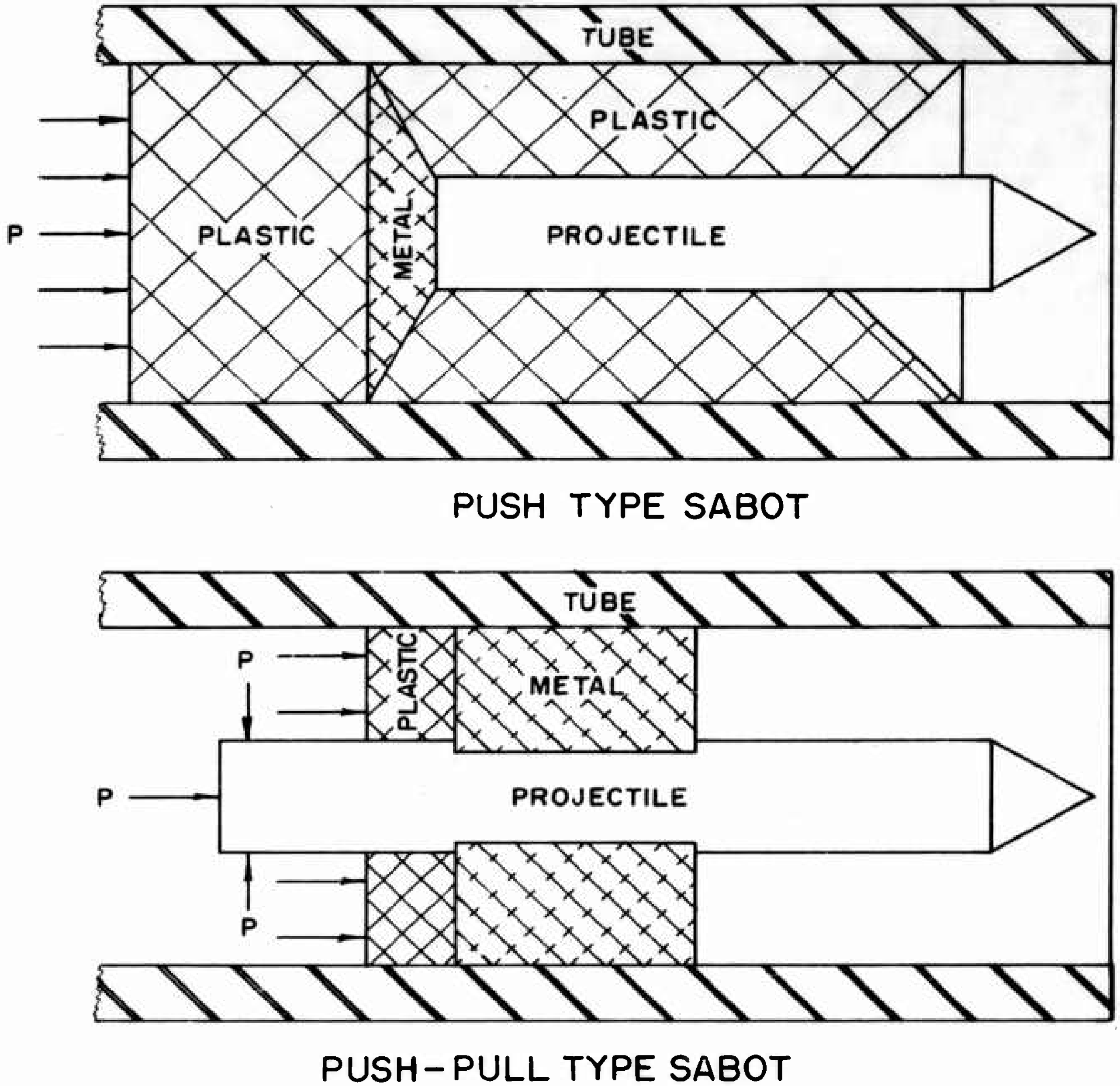
2. Murphy, C. H. and Taylor, Glenn An Interesting Sabot Design. BRL Memorandum Report No. 1304, September 1960.

3. Rogers, W. K. The Transonic Free Flight Range. BRL Report No. 1044, June 1958.

4. Keen, Stanley M. Applications of "Slit Cameras" for Observation and Data Acquisition in Projectile Studies. Proceedings of the Fifth International Congress on High Speed Photography, Washington, D. C., October 1960.

5. Gallagher, William J. Elements Which have Contributed to Dispersion in the 90/40mm Projectile. BRL Report No. 1013, March 1957.

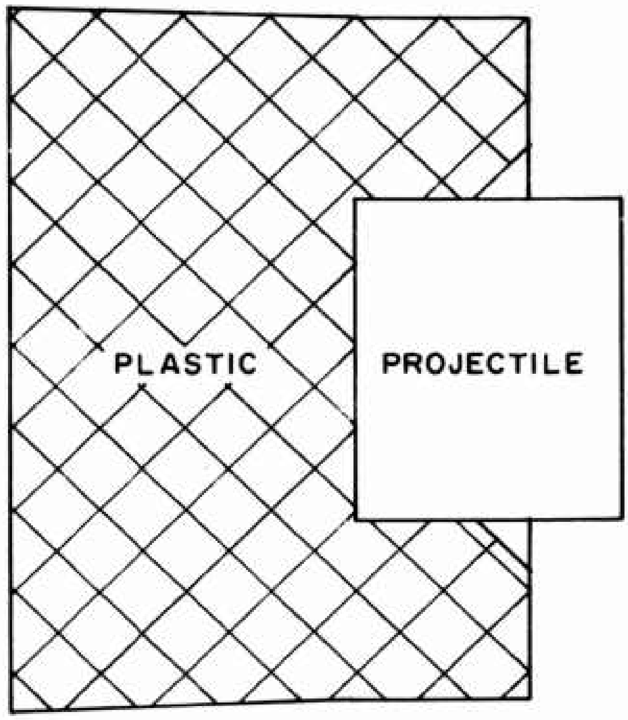
6. Marks, Spence T. and Boyer, Eugene D. A Second Test of an Upper Atmosphere Gun Probe System. BRL Memorandum Report No. 1464, April 1963.



P = PROPELLANT PRESSURE

FIG. I

PUSH TYPE SABOT



CYLINDRICAL PROJECTILE L/D = .75

FIG. 2

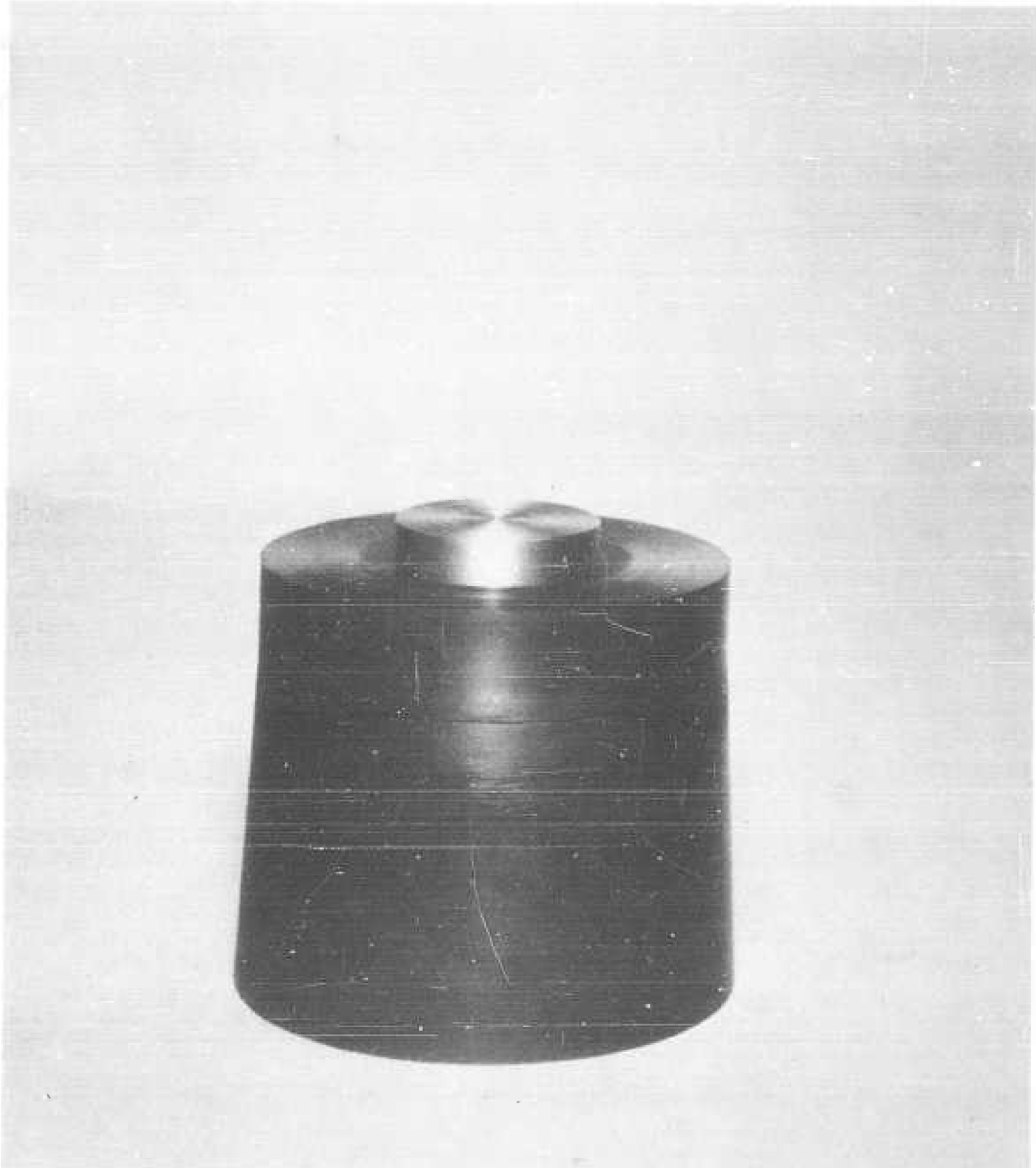


FIGURE 3. BASE-PUSH SABOT L/D = .75

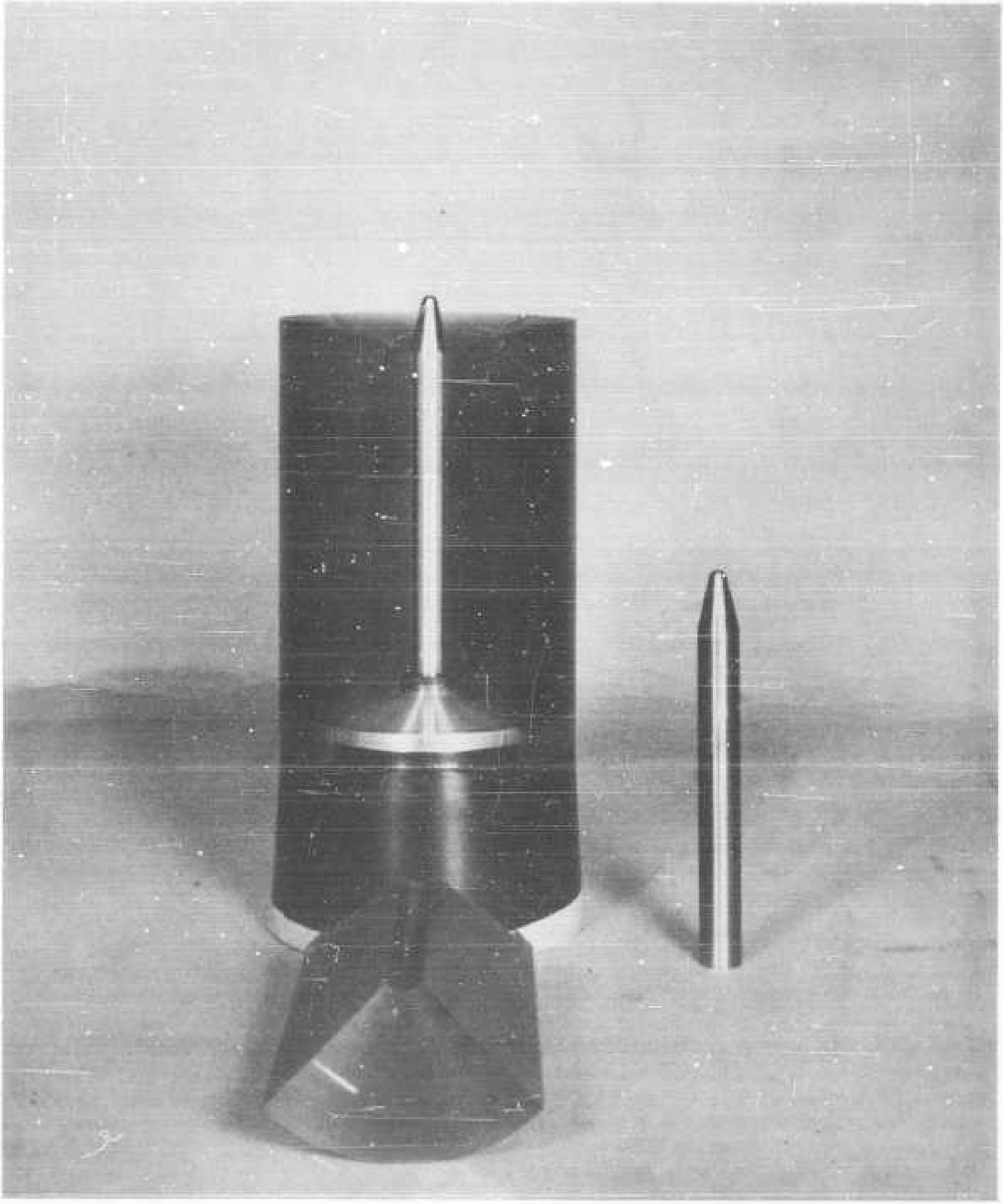
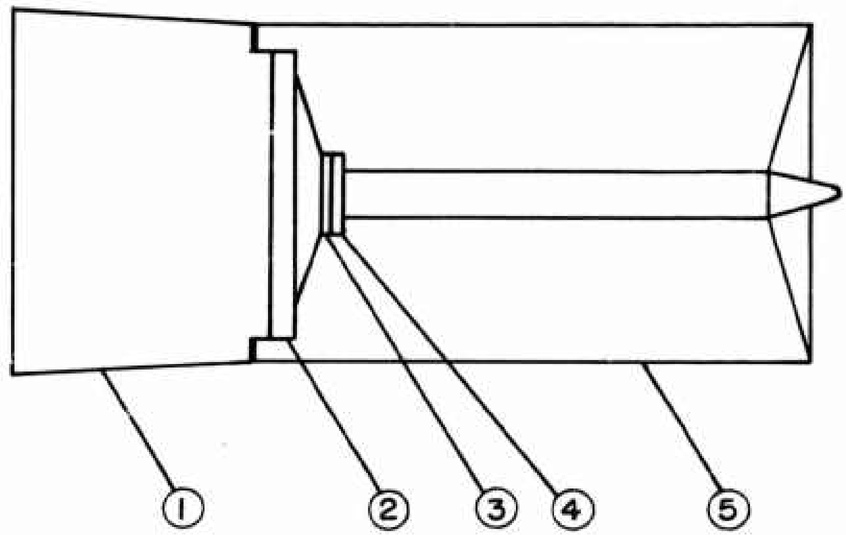


FIGURE 4. BASE-PUSH SABOT L/D = 10

PUSH TYPE SABOT
L/D ≤ 10



1 LEXAN (POLYCARBONATE RESIN) "BASE AND/OR OBTURATOR"

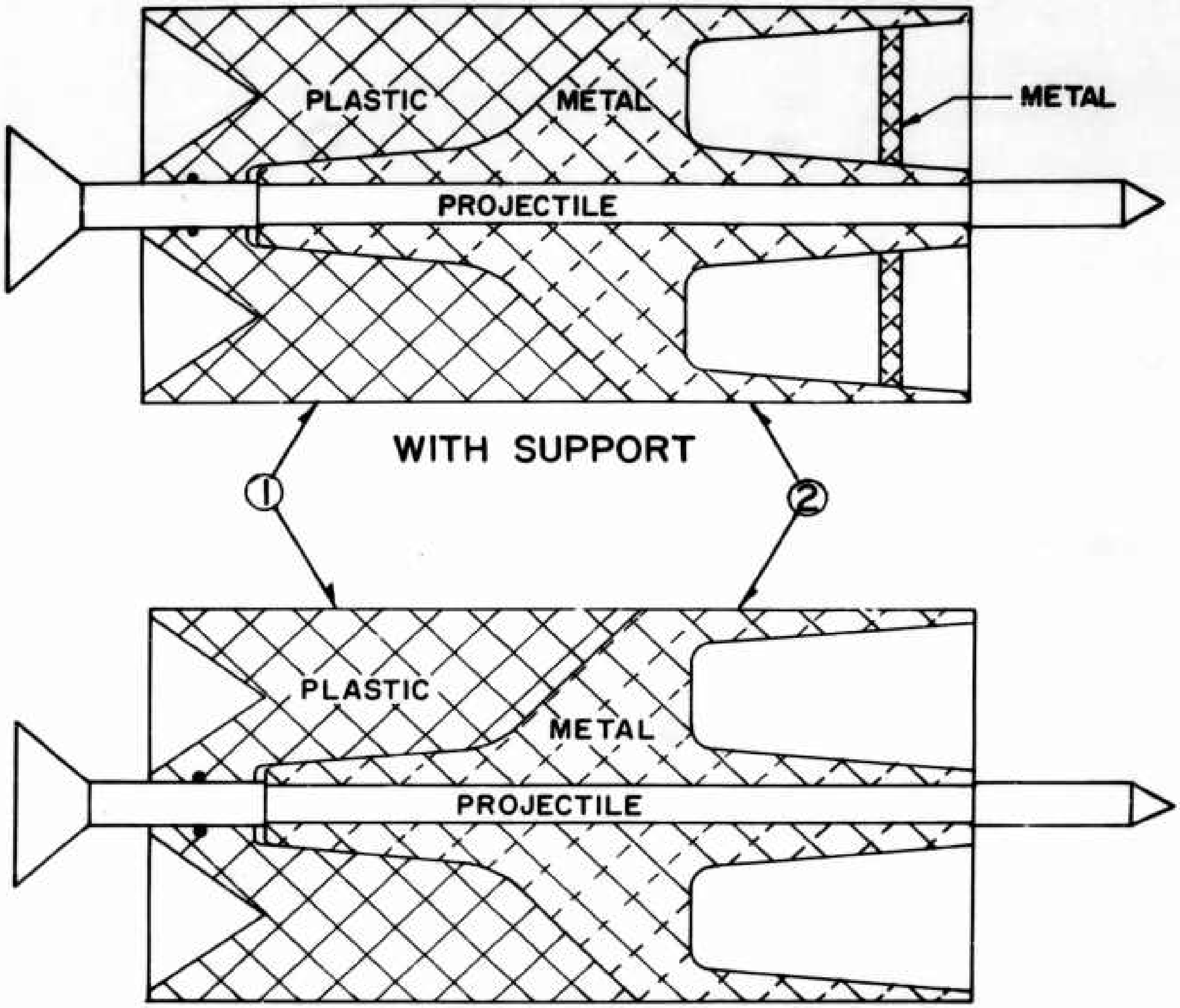
2 ALUMINUM (7075 T6 EXTRUDED) "DRIVER"

3 LEXAN (POLYCARBONATE RESIN) "SHOCK ABSORBER"

4 SOLAR STEEL "PAD"

5 ETHOCEL (ETHYL CELLULOSE) "CROWN"

FIG. 5



LESS SUPPORT

1. POLYCARBONATE RESIN
2. 7075 ST6 or 7178 ST6 ALUMINUM ALLOY

FIG. 6

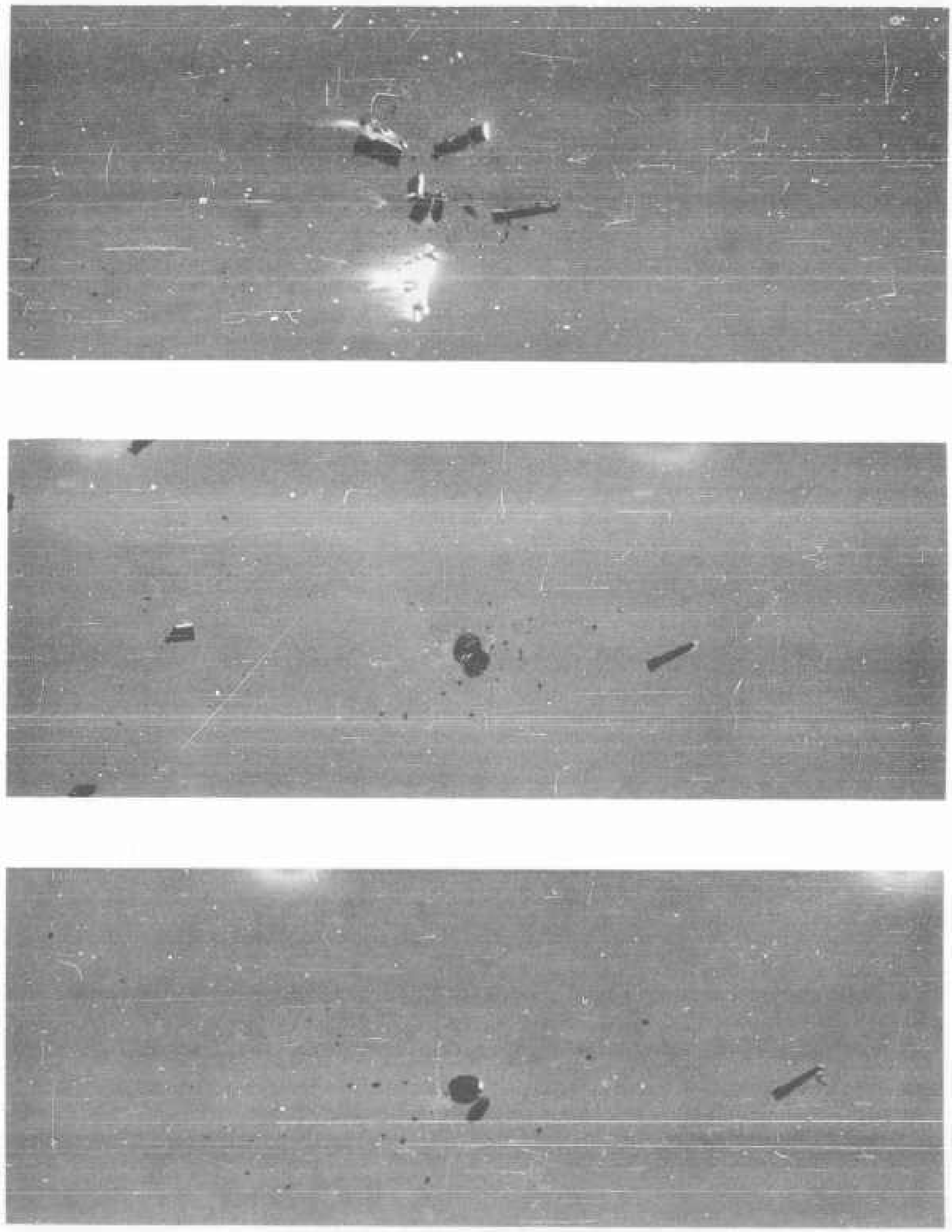


FIGURE 7. BASE-PUSH SABOT L/D = 25
Velocity 6400 fps Rd No. 6407

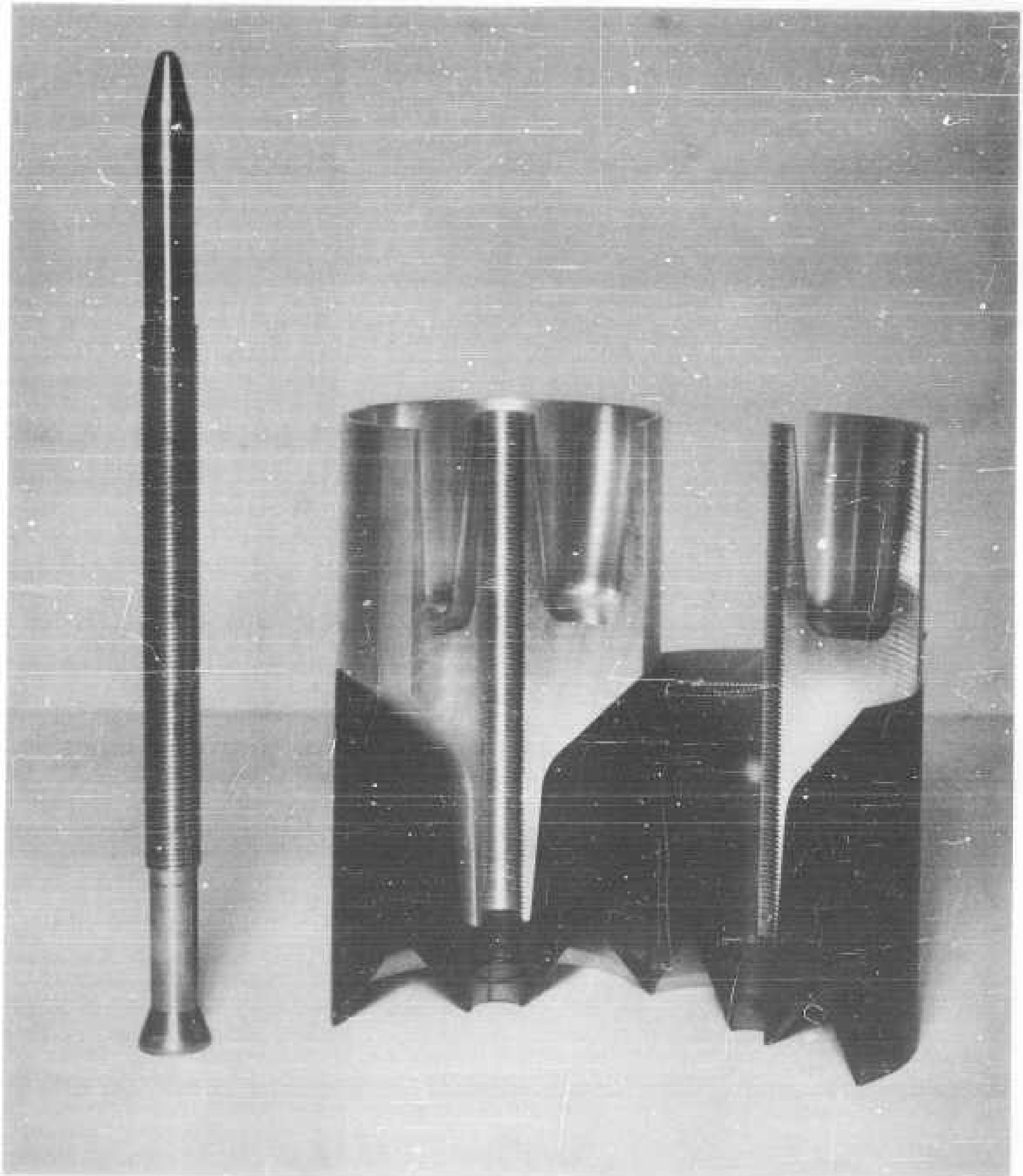


FIGURE 8. PUSH-PULL SABOT
Disassembled L/D > 10

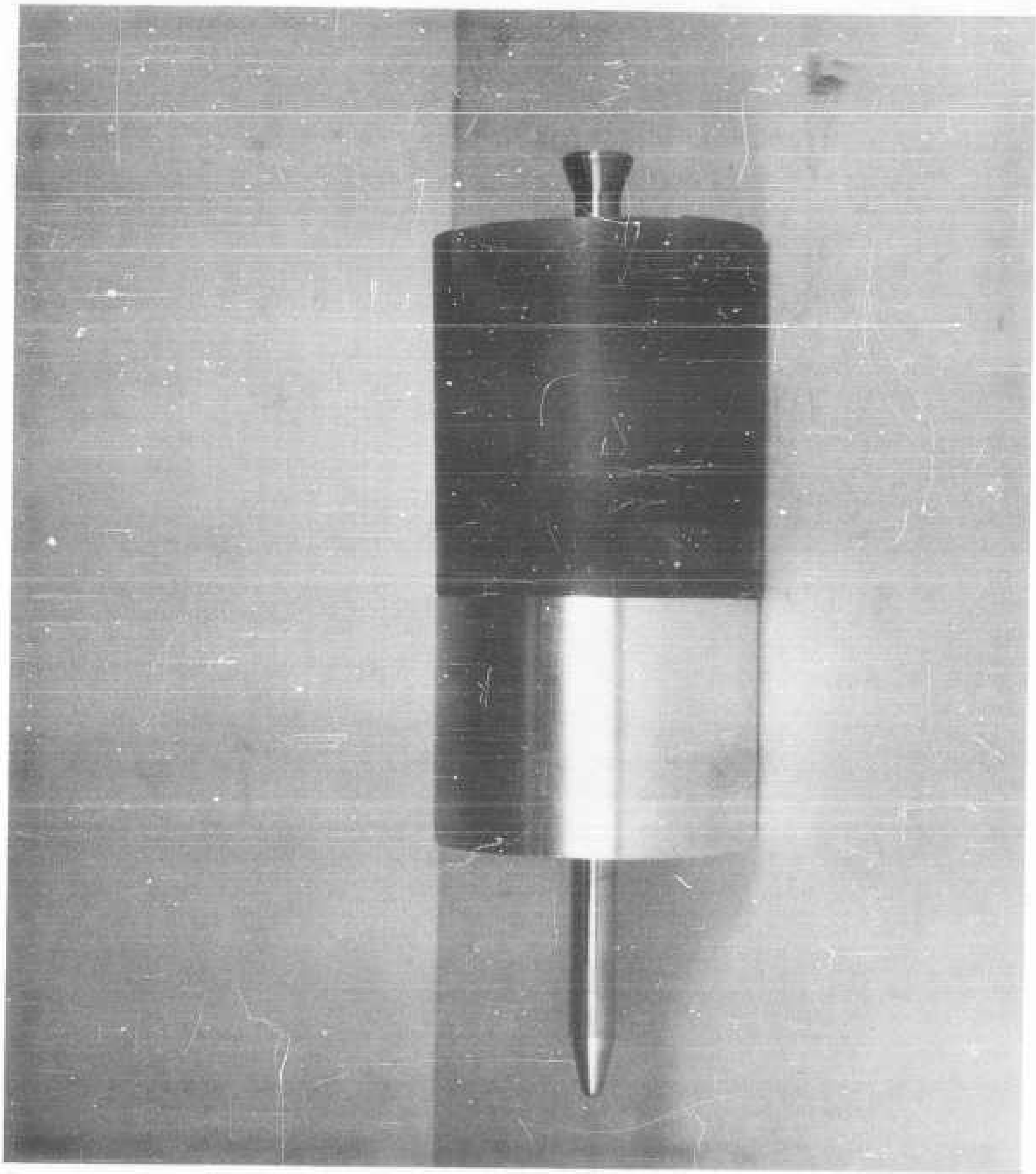


FIGURE 9. PUSH-PULL SABOT
Assembled L/D > 10

ROUND NO.	LAUNCH TUBE TYPE	PROPELLANT TYPE	PROPELLANT WT.	PACKAGE WT. (lbs.)	MODEL L/D	SABOT TYPE	PROJECTILE WT. (lbs.)	CHAMBER PRESSURE T20 GAGES	MUZZLE VELOCITY (ft./sec.)	BORE DIA. (SABOT) BEFORE FIRING (ins.)	CAMERA (Z=ft. from muzzle) (X=ft. from trajectory)	YAW CARD (Z=ft. from muzzle)	BASE MATERIAL	DRIVER MATERIAL	CROWN MATERIAL	OBTURATOR MATERIAL	DATE OF FIRING	HOUR OF FIRING	PROJECTILE MAT'L.
5974	105-mm T210	P 63949	22 lbs. 8 oz.	3.29	.75	PUSH	1.3	50,900 50,300	7370	4.134	Z=18 Z=35 Z=50 Z=70 X=25	120	POLY-CARBON-ATE "LEXAN"		POLY-CARBON-ATE "LEXAN"	POLY-CARBON-ATE "LEXAN"	3 MAY 1961	1115	STEEL
5975	105-mm T210	"	24 lbs. 9 oz.	5.64	10	PUSH	1.1	53,000 53,700	7820	4.134	Z=18 Z=35 Z=50 X=25	120	7075ST6 ALUM. ALLOY		"	"	3 MAY 1961	1400	TUNGSTEN
5976	105-mm T210	"	25 lbs. 4 oz.	2.89	.75	PUSH	1.3	65,400 65,400	8200	4.135	Z=18 Z=35 Z=50 Z=70 X=25	120	POLY-CARBON-ATE "LEXAN"		"	"	3 MAY 1961	1535	STEEL
5977	105-mm T210	"	24 lbs. 10 oz.	4.93	10	PUSH	1.0	66,800 65,500	7750	4.136	Z=18 Z=35 Z=50 Z=70 X=25	120	7075ST6 ALUM. ALLOY		"	"	4 MAY 1961	0930	TUNGSTEN
5978	105-mm T210	"	25 lbs. 0 oz.	3.63	.75	PUSH	1.3	66,800 66,400	7870	4.136	Z=18 Z=35 Z=50 Z=70 X=25	120	POLY-CARBON-ATE "LEXAN"		"	"	4 MAY 1961	1030	STEEL
6346	90-mm T208	"	15 lbs. 12 oz.	4.44	25	PUSH-PULL	1.3	78,800 79,400	3850	3.555	Z=40 Z=60 Z=100 X=25	120	"	7178ST6 ALUM. ALLOY		"	7 MAY 1962	1032	A 238 W/ SPRAY STEEL 80 SHEATH
6347	90-mm T208	"	14 lbs. 0 oz.	4.44	25	PUSH-PULL	1.3	49,000 48,900	4500	3.556	Z=40 Z=60 Z=100 X=25	120	"	"		"	7 MAY 1962	1158	A 238 W/ SPRAY STEEL 80 SHEATH
6348	90-mm T208	"	14 lbs. 0 oz.	4.42	24	PUSH-PULL	1.3	48,400 49,100	5957	3.557	Z=40 Z=60 Z=100 X=25	120	"	7075ST6 ALUM. ALLOY		"	7 MAY 1962	1420	A 238 W/ SPRAY STEEL 80 SHEATH
6349	90-mm T208	"	15 lbs. 0 oz.	4.39	25	PUSH-PULL	1.3	57,900 57,400	6400	3.559	Z=40 Z=60 Z=100 X=25	120	"	7178ST6 ALUM. ALLOY		"	8 MAY 1962	1020	A 238 W/ SPRAY STEEL 80 SHEATH
6350	90-mm T208	"	14 lbs. 0 oz.	4.44	25	PUSH-PULL	1.3	49,100 49,200	6260	3.560	Z=40 Z=60 Z=100 X=25	120	"	"		"	8 MAY 1962	1320	A 238 W/ SPRAY STEEL 80 SHEATH
6407	90-mm T208	"	15 lbs. 0 oz.	5.70	25	PUSH	1.5	66,800 63,100	6400	3.562	Z=25 Z=55 Z=70 X=25	140	7075ST6 ALUM. ALLOY		POLY-CARBON-ATE "LEXAN"	"	10 JULY 1962	1125	TUNGSTEN W/ 7178 ST6 SHEATH
6408	90-mm T208	"	15 lbs. 8 oz.	4.82	25	PUSH-PULL	1.3	61,000 67,100	6800	3.564	Z=25 Z=55 Z=70 X=25	140	POLY-CARBON-ATE "LEXAN"	7178ST6 ALUM. ALLOY		"	10 JULY 1962	1410	TUNGSTEN W/CHROME-MOLY STEEL SHEATH
6409	90-mm T208	"	15 lbs. 5 oz.	6.07	25	PUSH	1.5	72,700 69,900 69,800	6500	3.565	Z=25 Z=55 Z=70 X=25	140	7075ST6 ALUM. ALLOY		POLY-CARBON-ATE "LEXAN"	"	10 JULY 1962	1600	TUNGSTEN W/ 7178 ST6 SHEATH

FIG. 10 DATA SHEET

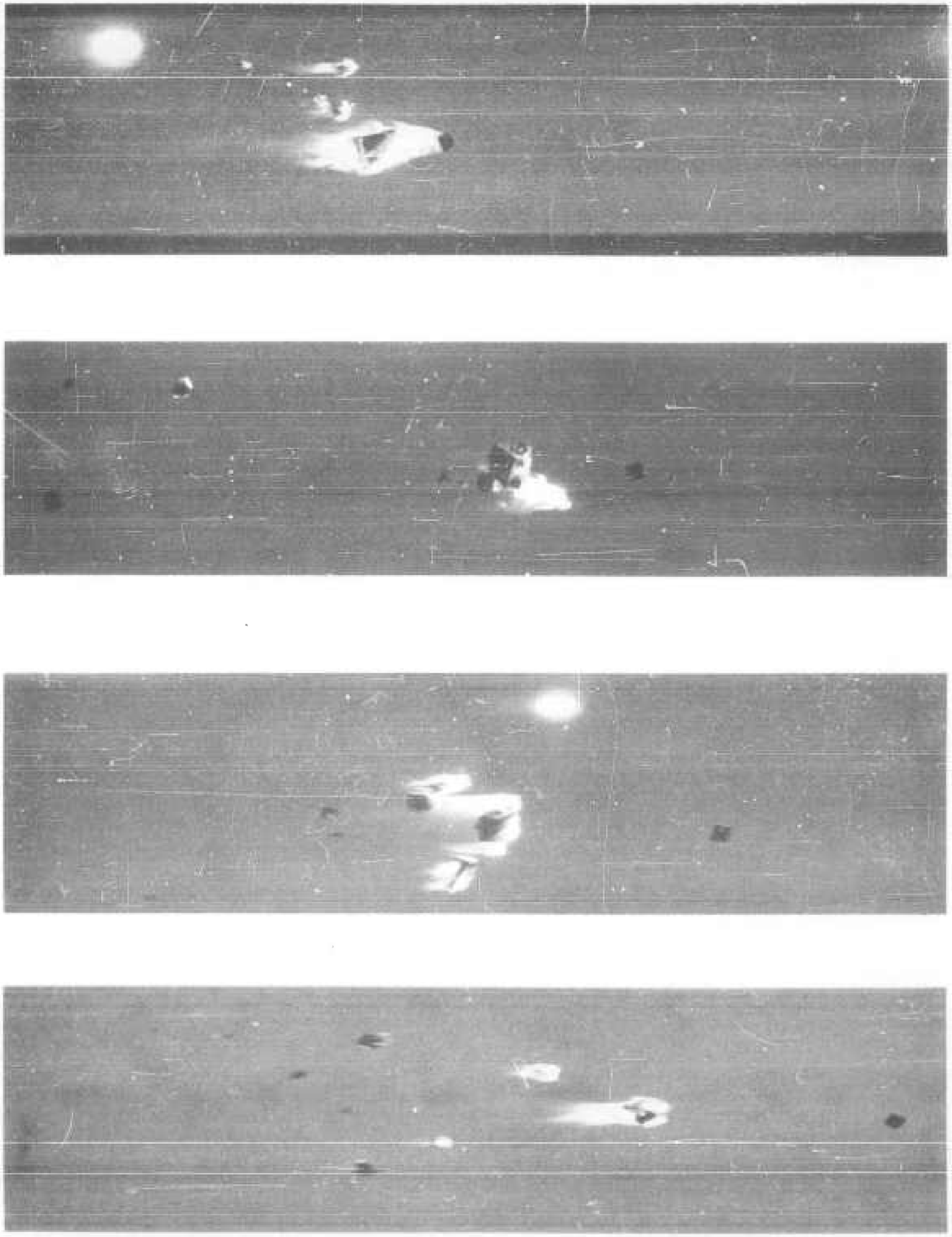


FIGURE 11. BASE-PUSH SABOT L/D = .75
Velocity 7370 fps Rd No. 5974

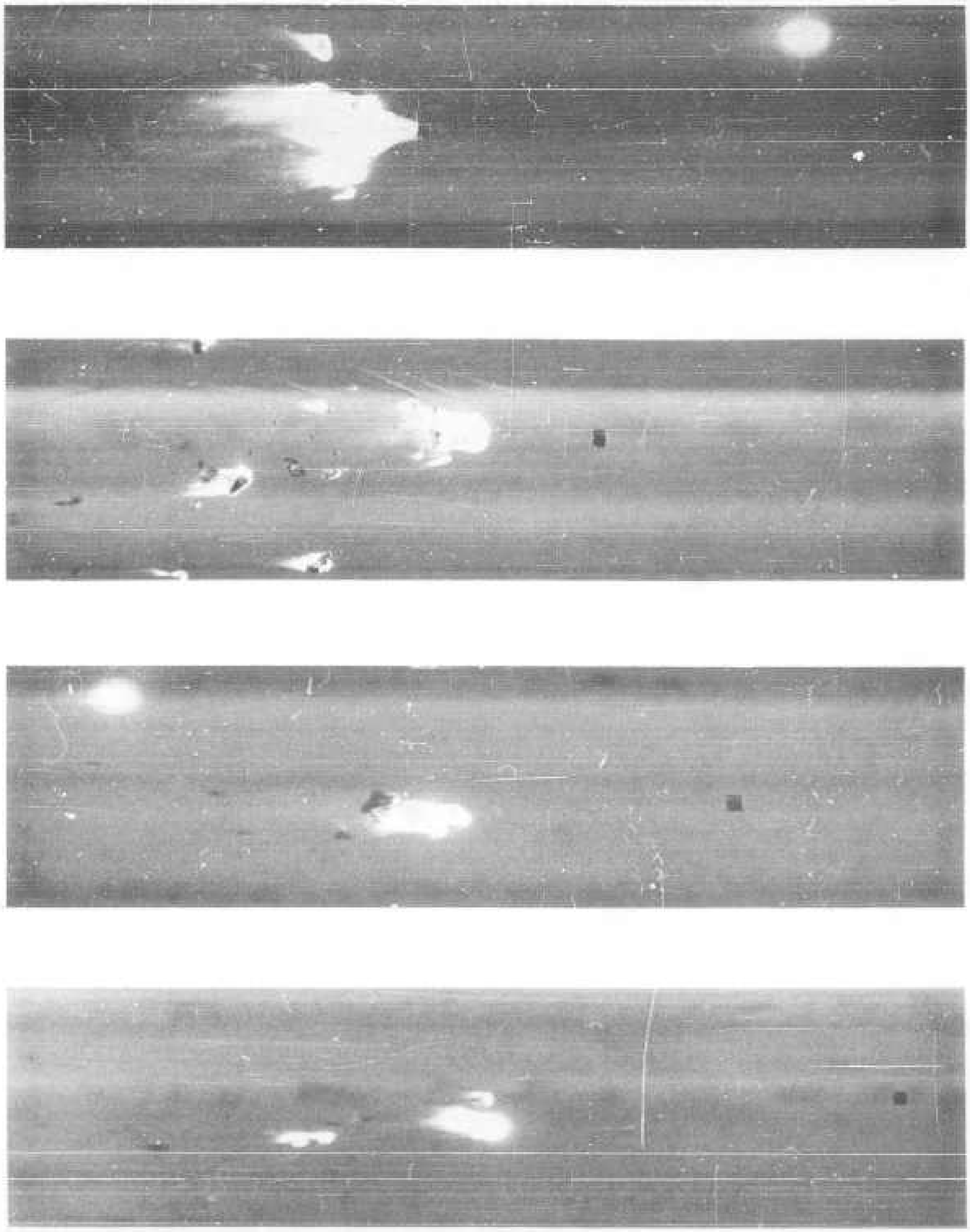


FIGURE 12. BASE-PUSH SABOT L/D = .75
Velocity 8200 fps Rd No. 5976

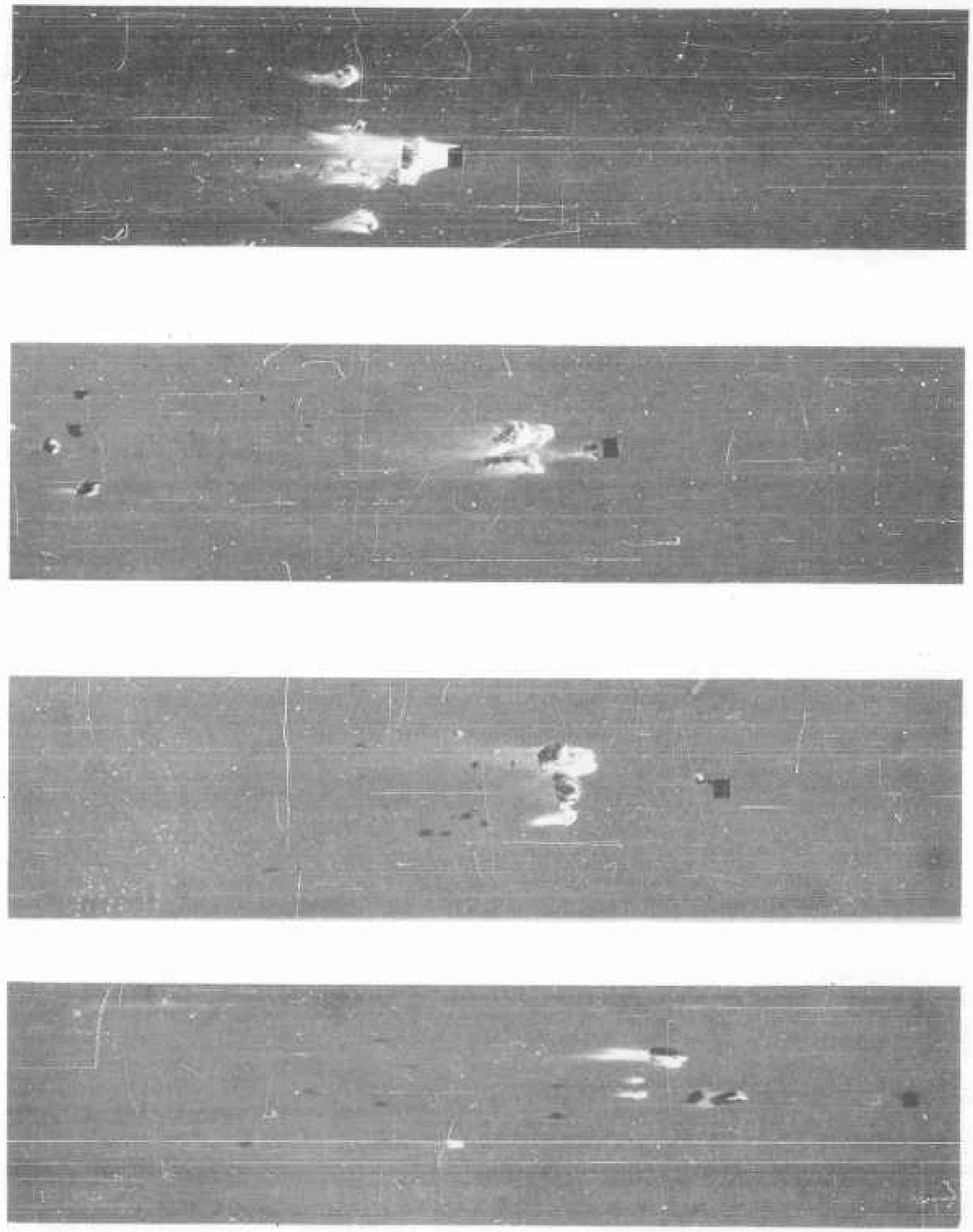


FIGURE 13. BASE-PUSH SABOT L/D = .75
Velocity 7870 fps Rd No. 5978

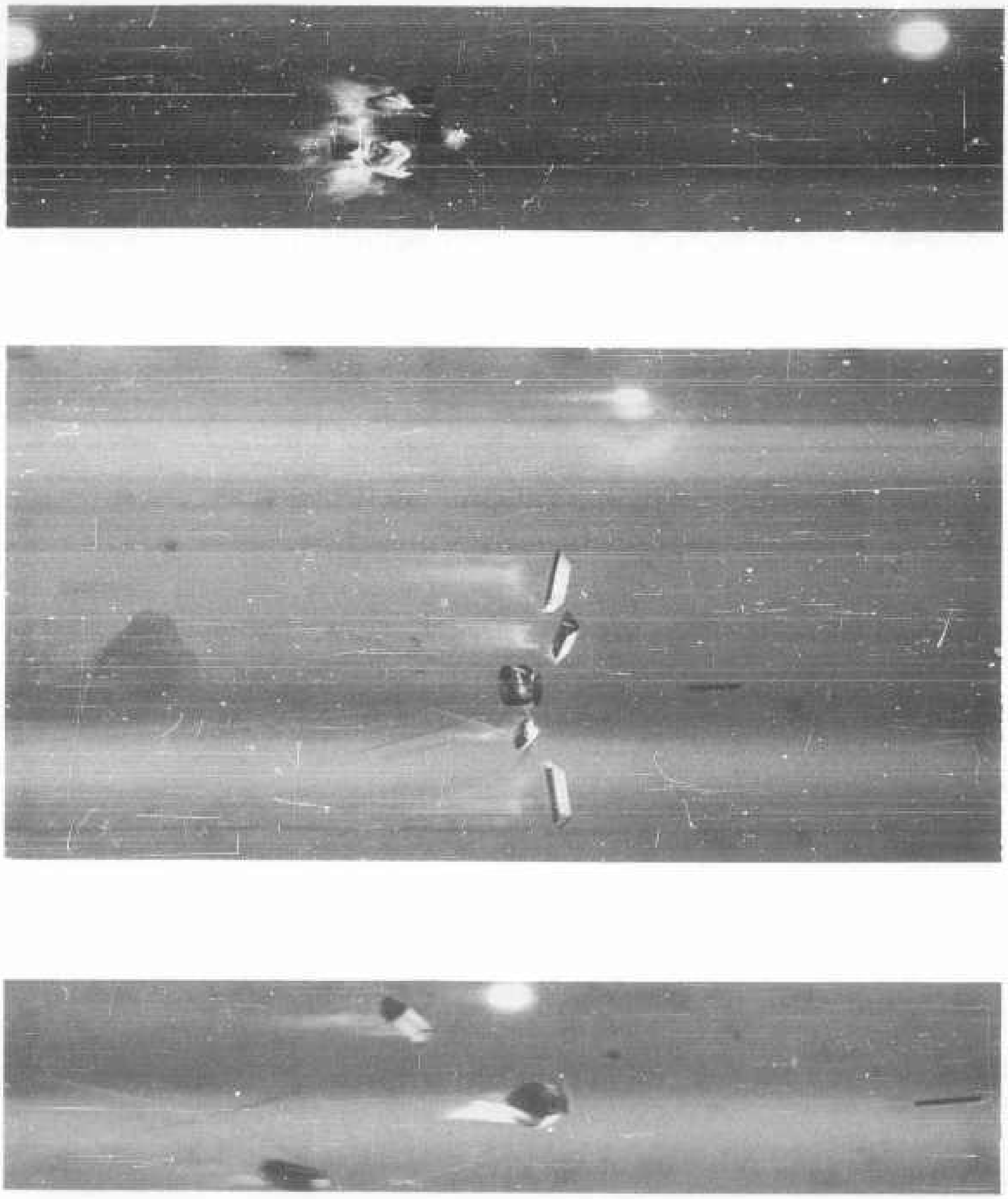


FIGURE 14. BASE-PUSH SABOT L/D = 10
Velocity 7820 fps Rd No. 5975

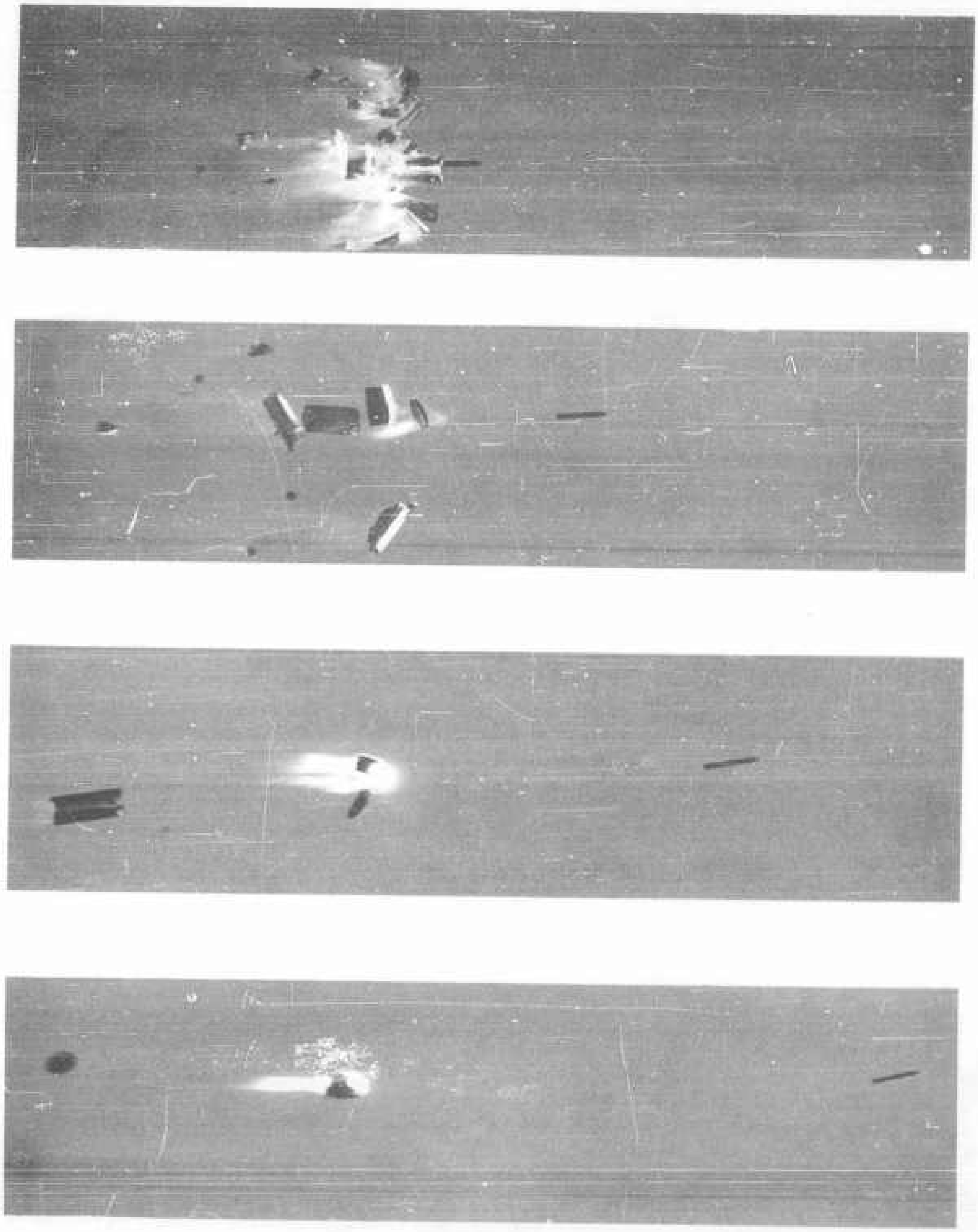


FIGURE 15. BASE-PUSH SABOT L/D = 10
Velocity 7750 fps Rd No. 5977

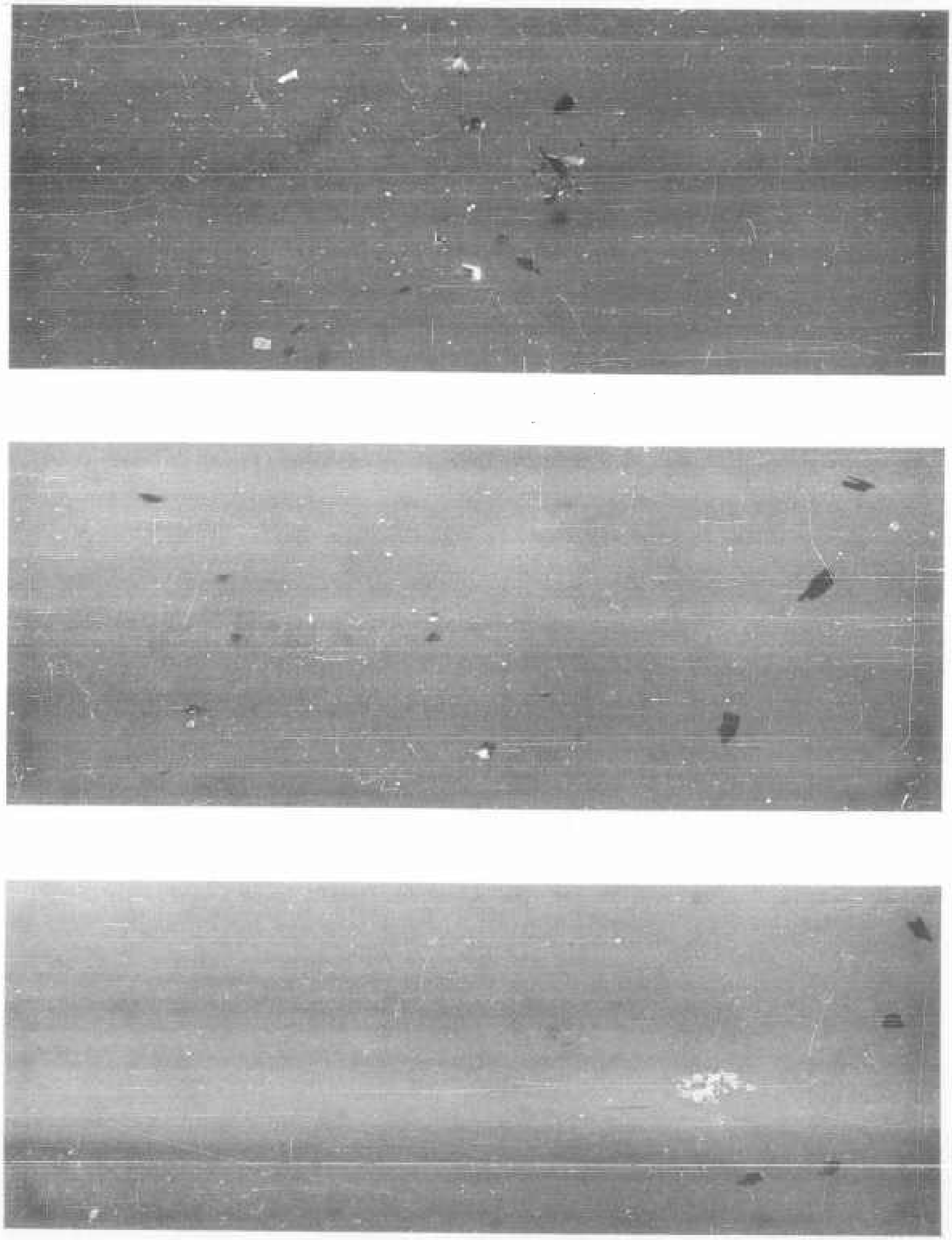


FIGURE 16. PUSH-PULL SABOT L/D = 25
Velocity 3850 fps Rd No. 6346

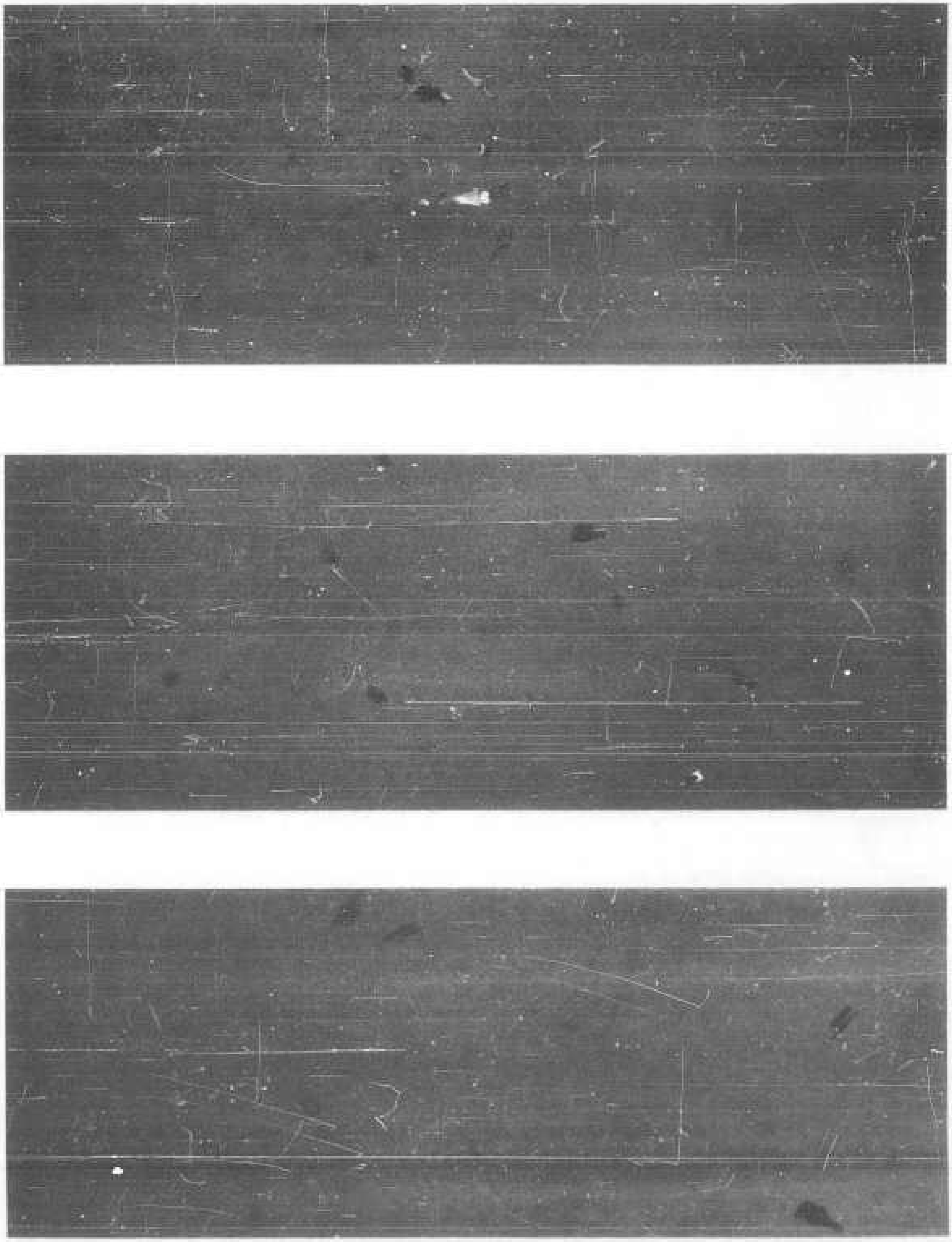


FIGURE 17. PUSH-PULL SABOT L/D = 25
Velocity 4500 fps Rd No. 6347

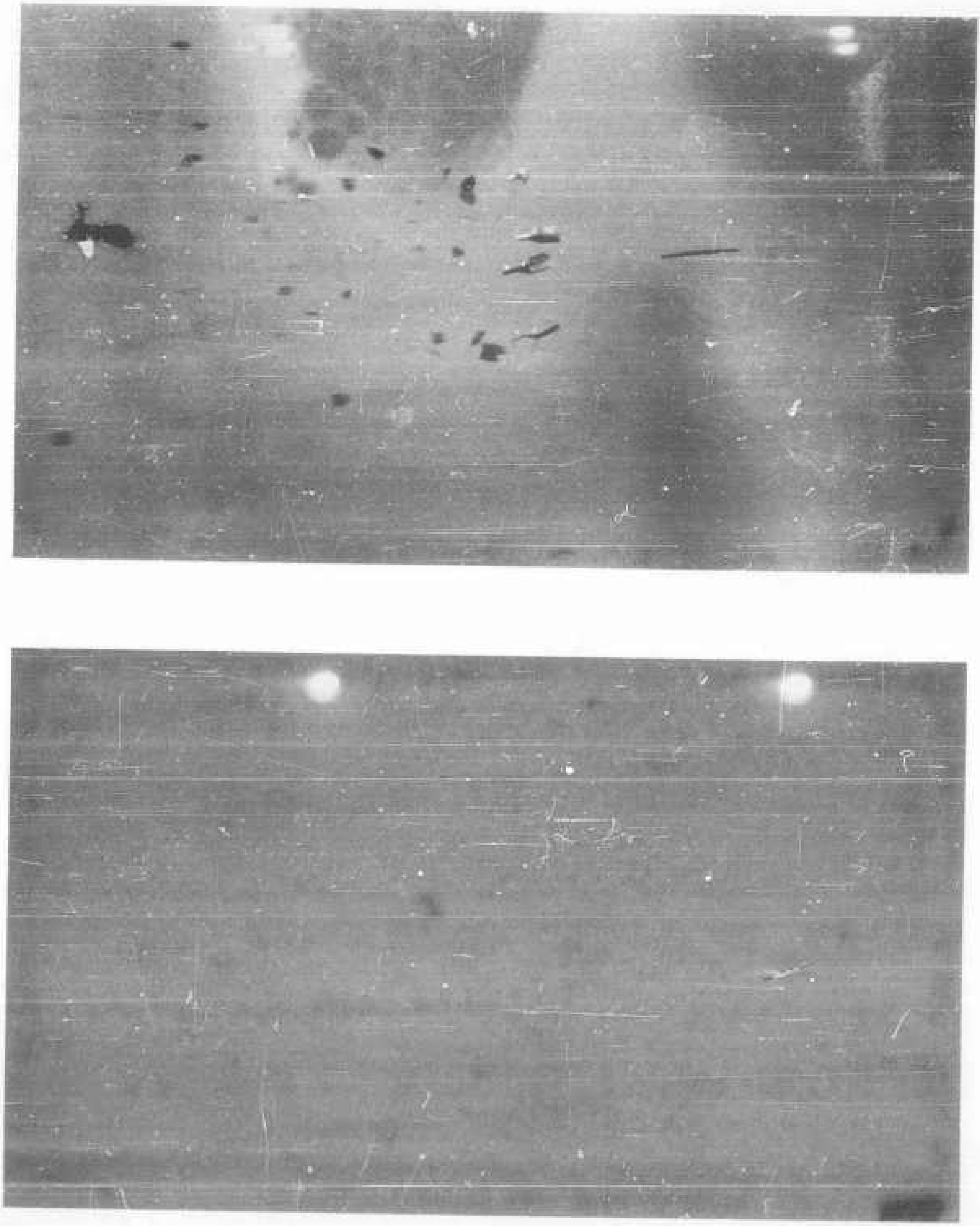


FIGURE 18. PUSH-PULL SABOT L/D = 24
Velocity 5957 fps Rd No. 6348

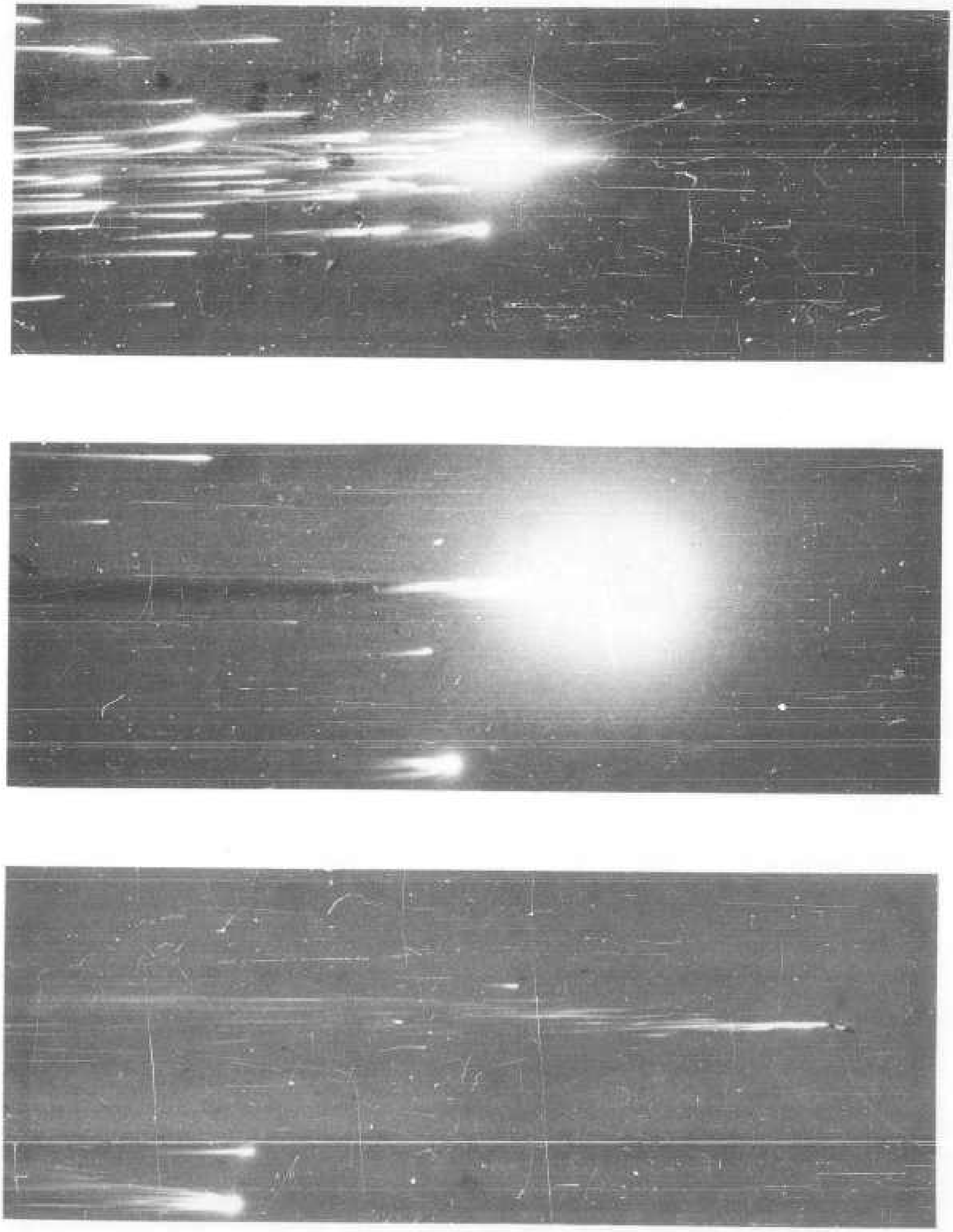


FIGURE 19. PUSH-PULL SABOT L/D = 25
Velocity 6400 fps Rd No. 6349

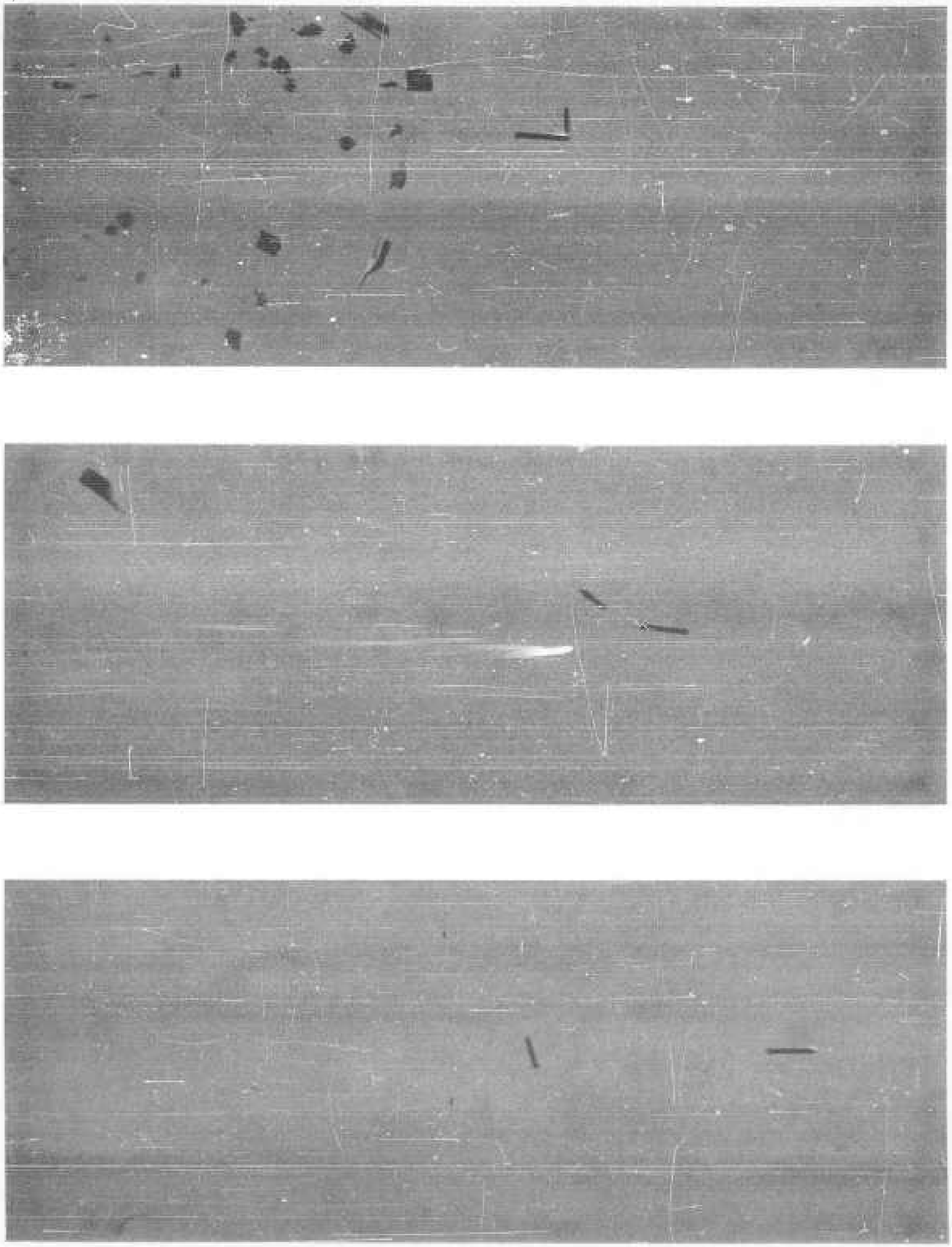
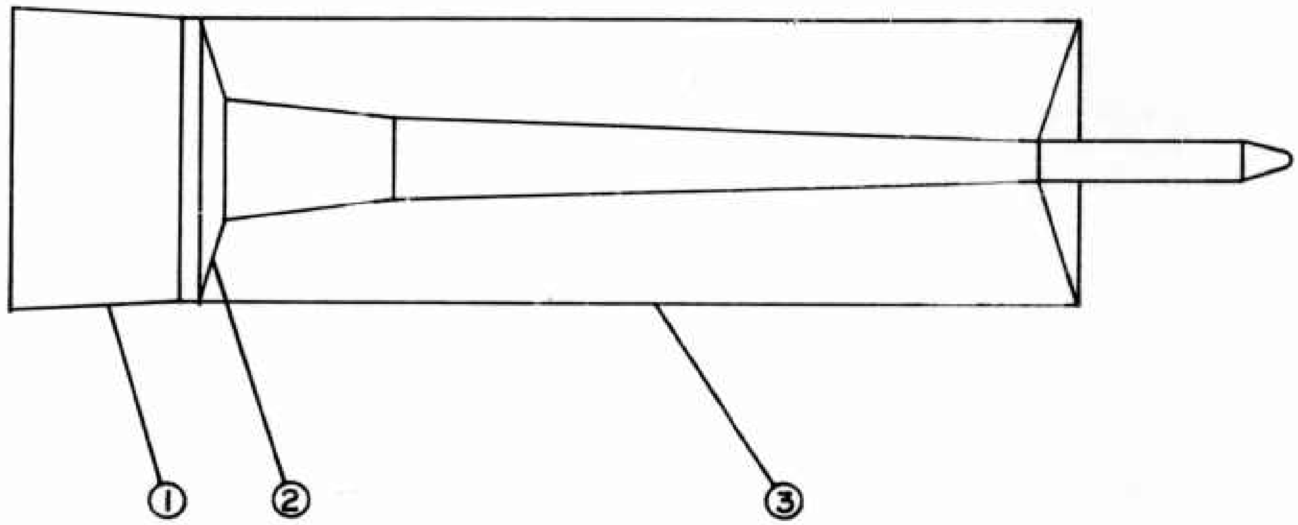


FIGURE 20. PUSH-PULL SABOT L/D = 25
Velocity 6260 fps Rd No. 6350

PUSH TYPE SABOT
L/D >10



① LEXAN (POLYCARBONATE RESIN) "BASE AND/OR OBTURATOR"

② ALUMINUM (7075 T6 EXTRUDED ROD) "DRIVER"

③ LEXAN (POLYCARBONATE RESIN) "CROWN"

FIG. 21

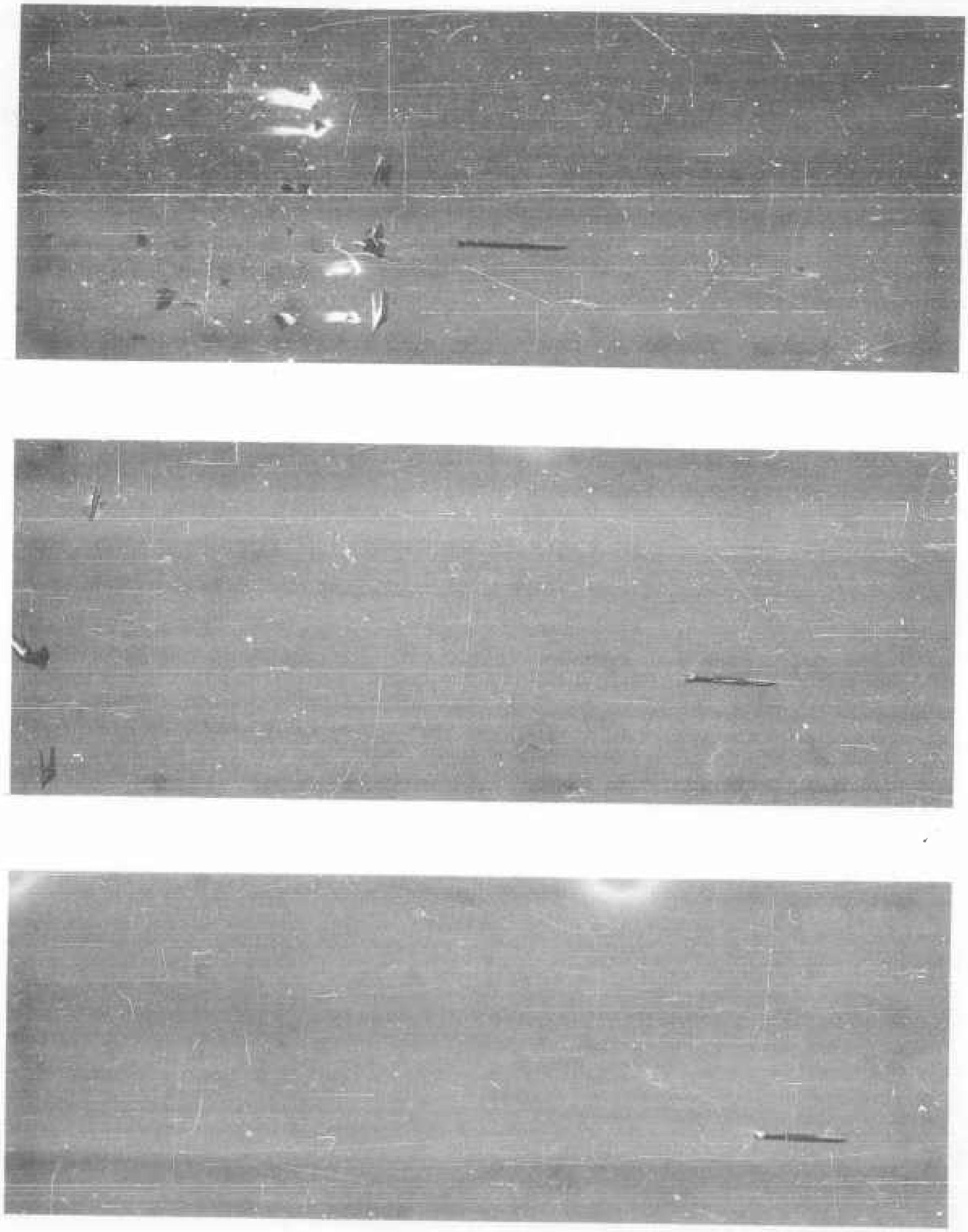


FIGURE 22. PUSH-PULL SABOT L/D = 25
Velocity 6800 fps Rd No. 6408

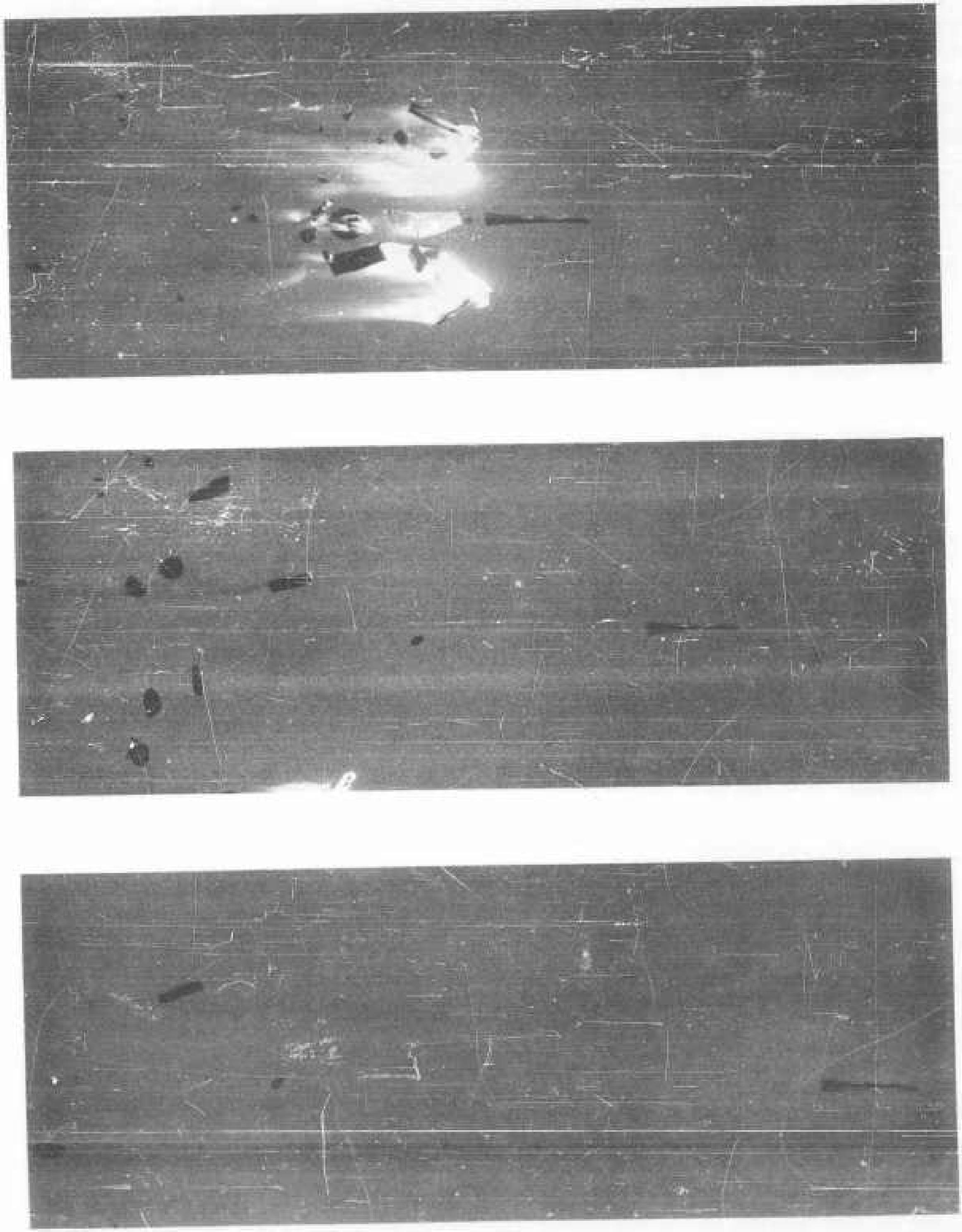


FIGURE 23. BASE-PUSH SABOT L/D = 25
Velocity 6500 fps Rd No. 6409

DISTRIBUTION LIST

No. of Copies	Organization
20	Commander Defense Documentation Center ATTN: TIPCR Cameron Station Alexandria, Virginia 22314
1	Director Defense Research and Engineering (OSD) ATTN: Director/Ordnance Washington, D. C. 20301
1	Commanding General U. S. Army Materiel Command ATTN: AMCRD-RP-B Washington, D. C. 20315
1	Commanding General U. S. Army Materiel Command ATTN: AMCRD-DM Washington, D. C. 20315
3	Commanding Officer Picatinny Arsenal Dover, New Jersey 07801
2	Commanding Officer Frankford Arsenal ATTN: Library Branch Philadelphia 37, Pennsylvania 19137
1	Commanding Officer Harry Diamond Laboratories ATTN: Technical Information Office Branch 012 Washington, D. C. 20438
1	Commanding General U. S. Army Missile Command Redstone Arsenal, Alabama 35809
1	Commanding Officer U. S. Army Chemical Warfare Laboratories Edgewood Arsenal, Maryland 21040
1	Army Research Office 3045 Columbia Pike Arlington, Virginia
1	Director Operations Research Office Department of the Army 6935 Arlington Road Bethesda, Maryland Washington 14, D. C.
3	Chief Bureau of Naval Weapons ATTN: DLI-3 Department of the Navy Washington, D. C. 20360
2	Commander U. S. Naval Weapons Laboratory Dahlgren, Virginia
2	Commander Naval Ordnance Laboratory White Oak Silver Spring 19, Maryland
1	Commanding Officer and Director David W. Taylor Model Basin ATTN: Mrs. Ruby S. Craven Aerodynamics Laboratory Washington 7, D. C.
2	Commander U. S. Naval Missile Center Point Mugu, California 93041
1	Commander Naval Air Development Center Johnsville, Pennsylvania
1	Commanding Officer Naval Air Rocket Test Station Dover, New Jersey

DISTRIBUTION LIST

No. of Copies	Organization
2	Commander U. S. Naval Ordnance Test Station ATTN: Technical Library Aeroballistics Laboratory Code 5034 China Lake, California
1	U. S. Naval Research Laboratory ATTN: H. F. Swift Impact Damage Section Washington 25, D. C.
3	AEDC ATTN: Deputy Chief of Staff R&D Arnold Air Force Station Tullahoma, Tennessee 37389
4	AFSC (SCRR2) Andrews Air Force Base Washington 25, D. C. 20331
1	APGC (PGWRR - P. W. Myers) Eglin Air Force Base Florida 32542
1	Director National Aeronautics and Space Administration Ames Research Center ATTN: A. G. Boissevain Aeronautics Research Engineer Moffett Field, California
1	ARO, Inc. von Karman Gas Dynamics Facility Arnold Engineering Development Center ATTN: J. Lukasiewicz, Chief, VKF Arnold Air Force Station Tennessee 37389
1	The Budd Company Red Lion Plant ATTN: Mr. Kessler Red Lion and Verree Roads Philadelphia 15, Pennsylvania 19132
1	Douglas Aircraft, Inc. ATTN: Mr. Ross Radey Charlotte, North Carolina
1	General Electric Company ATTN: Mr. A. M. Smith Valley Forge, Pennsylvania 19101
1	General Motors Research Division ATTN: Mr. W. K. Rogers Santa Barbara, California
1	Massachusetts Institute of Technology Lincoln Laboratory ATTN: Mr. R. E. Slattery P. O. Box 73 Lexington 73, Massachusetts
1	Institut Franco-Allemand de Recherches de Saint Louis 12, rue de l'Industrie ATTN: Ingenieur Militaire en Chef Auriol Saint Louis (Haut Rhin) France
1	Laboratoire de Recherches Balistiques et Aerodynamiques ATTN: L'Ingenieur Militaire General Girardin Directeur Vernon (Eure) France
4	Australian Group c/o Military Attache Australian Embassy 2001 Connecticut Avenue, N.W. Washington 8, D. C.

DISTRIBUTION LIST

No. of Copies	Organization
11	The Scientific Information Officer Defence Research Staff British Embassy 3100 Massachusetts Avenue, N.W. Washington 8, D. C. Of Interest to: Armament Research and Development Establishment ATTN: F. Smith S/B3, ARDE Fort Halstead Sevenoaks, Kent, England
5	Defence Research Member Canadian Joint Staff 2450 Massachusetts Avenue, N.W. Washington 8, D. C. Of Interest to: Canadian Armament Research and Development Establishment ATTN: G. Tidy Aero/Physics Wing P. O. Box 1427 Quebec, P. G., Canada

AD ______________ Accession No. ______________ UNCLASSIFIED

Ballistic Research Laboratories, APG
SABOT-LAUNCHING SYSTEMS FOR EXPERIMENTAL PENETRATORS
Glenn Taylor

BRL Memorandum Report No. 1505 August 1963

RDT & E Project No. 1M010501A005
UNCLASSIFIED Report

Aerodynamic Testing
Terminal Ballistic Testing
Penetrators - Launching
Sabots
Model Projectiles

Performance details for special purpose, high velocity sabots are described. These sabots were designed and developed for launching high density projectiles, of rod form, with overall length to diameter ratios varying from less than one to twenty-five.

AD ______________ Accession No. ______________ UNCLASSIFIED

Ballistic Research Laboratories, APG
SABOT-LAUNCHING SYSTEMS FOR EXPERIMENTAL PENETRATORS
Glenn Taylor

BRL Memorandum Report No. 1505 August 1963

RDT & E Project No. 1M010501A005
UNCLASSIFIED Report

Aerodynamic Testing
Terminal Ballistic Testing
Penetrators - Launching
Sabots
Model Projectiles

Performance details for special purpose, high velocity sabots are described. These sabots were designed and developed for launching high density projectiles, of rod form, with overall length to diameter ratios varying from less than one to twenty-five.

AD ______________ Accession No. ______________ UNCLASSIFIED

Ballistic Research Laboratories, APG
SABOT-LAUNCHING SYSTEMS FOR EXPERIMENTAL PENETRATORS
Glenn Taylor

BRL Memorandum Report No. 1505 August 1963

RDT & E Project No. 1M010501A005
UNCLASSIFIED Report

Aerodynamic Testing
Terminal Ballistic Testing
Penetrators - Launching
Sabots
Model Projectiles

Performance details for special purpose, high velocity sabots are described. These sabots were designed and developed for launching high density projectiles, of rod form, with overall length to diameter ratios varying from less than one to twenty-five.

AD ______________ Accession No. ______________ UNCLASSIFIED

Ballistic Research Laboratories, APG
SABOT-LAUNCHING SYSTEMS FOR EXPERIMENTAL PENETRATORS
Glenn Taylor

BRL Memorandum Report No. 1505 August 1963

RDT & E Project No. 1M010501A005
UNCLASSIFIED Report

Aerodynamic Testing
Terminal Ballistic Testing
Penetrators - Launching
Sabots
Model Projectiles

Performance details for special purpose, high velocity sabots are described. These sabots were designed and developed for launching high density projectiles, of rod form, with overall length to diameter ratios varying from less then one to twenty-five.

UNCLASSIFIED

UNCLASSIFIED